MOD. 615

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INSTRUCTION MANUAL

for

MODEL 615

TV SWEEP AND MARKER ALIGNMENT GENERATOR

THE HICKOK ELECTRICAL INSTRUMENT COMPANY • 10514 DUPONT AVENUE • CLEVELAND 8, OHIO

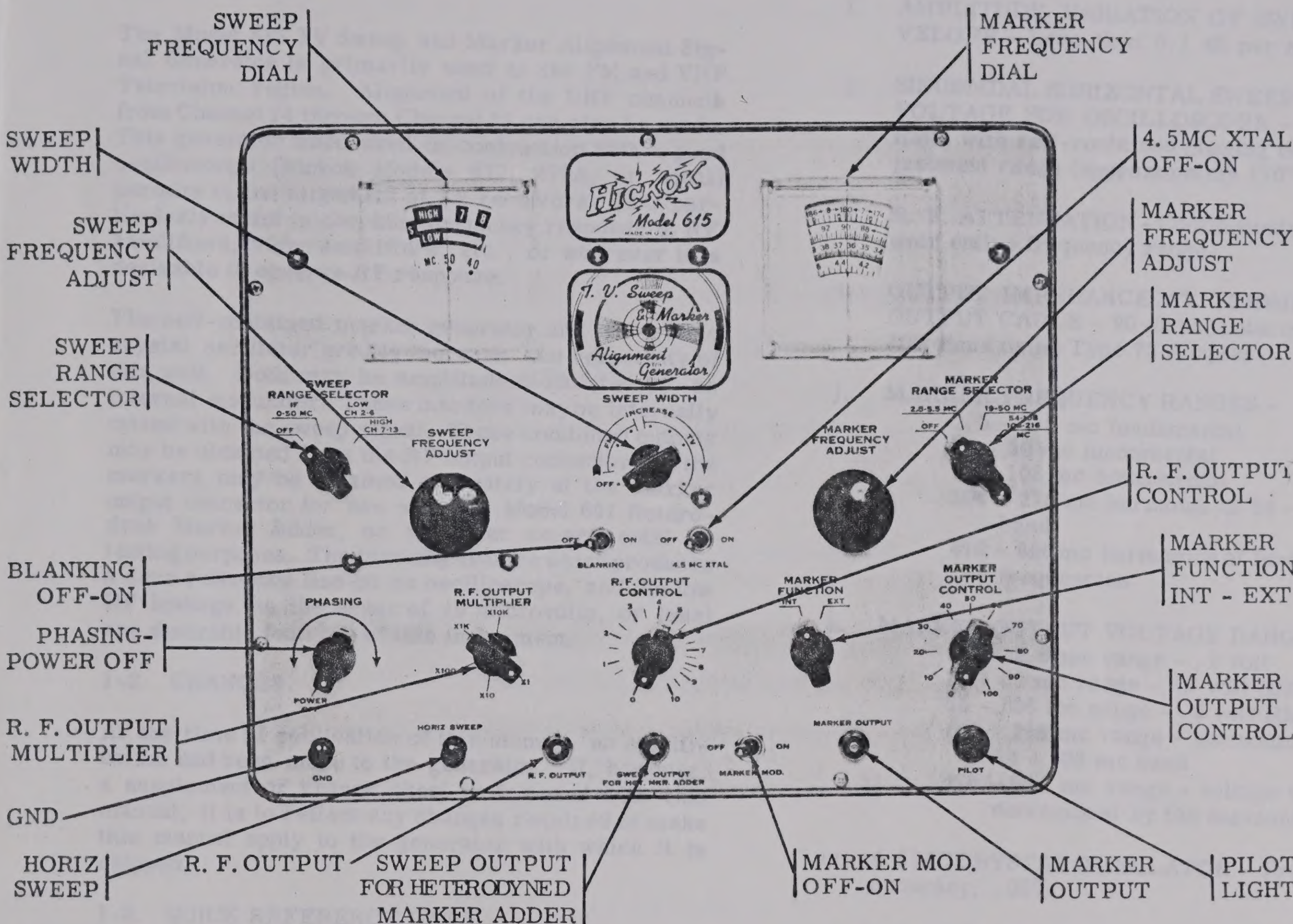

Figure 2-1. Front Panel Controls and Connectors

SECTION 1

GENERAL DESCRIPTION

1-1. GENERAL

The Model 615 TV Sweep and Marker Alignment Signal Generator is primarily used in the FM and VHF Television region. Alignment of the UHF channels from Channel 14 through Channel 83 can also be made. This generator when used in conjunction with a good oscilloscope (Hickok Models 677, 675A, or equal) permits visual alignment of TV receivers. It is particularly useful in checking frequency response in RF amplifiers, video amplifiers, etc., or wherever it is desirable to observe RF response.

The self-contained marker generator and the 4.5 mc crystal oscillator greatly increase the versatility of this unit. Both may be amplitude modulated by an internal modulator. These markers may be internally mixed with the sweep signal. These combined outputs may be obtained from the RF output connector, or the markers may be obtained separately at the marker output connector, for use with the Model 691 Heterodyne Marker Adder, or for other experimental or testing purposes. The blanking feature which produces a zero reference line on an oscilloscope, and the low RF leakage (in the order of 10 microvolts, or less) are desirable features of this instrument.

1-2. CHANGES

At the time of publication of this manual, no modification had been made to the generator. If, however, a supplement or change sheet is included with this manual, it is to reflect any changes required to make this manual apply to the generator with which it is shipped.

1-3. QUICK REFERENCE DATA

a. POWER REQUIREMENTS - 115/220 volts, 50/60 cycles, 25 watts.

b. FREQUENCY MODULATED RANGES -
0-50 mc - I. F. heterodyned
50-100 mc - Low Band heterodyned output
175-225 mc - High Band fundamental output
470-890 mc - Low and High Band harmonics

c. SWEEP DEVIATION - 0-15 mc, ±3 mc

d. SWEEP FREQUENCY REPETITION RATE - Power line frequency

e. SWEEP OUTPUT VOLTAGES -
0-50 mc (I. F. range) - .07 volts RMS
Channels 2 through 6 - .07 volts RMS
Channels 7 through 13 - .12 volts RMS
Channels 14 through 83 - voltage varies, determined by the harmonic used.

f. AMPLITUDE VARIATION OF SWEEP ENVELOPE - Less than 0.1 db per megacycle

g. SINUSOIDAL HORIZONTAL SWEEP OUTPUT VOLTAGE FOR OSCILLOSCOPE - 1.5 volts RMS, with self-contained phasing control adjustment range (approximately 170°)

h. R. F. ATTENUATION - Continuously variable over entire frequency range

i. OUTPUT IMPEDANCE AT TERMINALS OF OUTPUT CABLE - 90 ohms, unterminated - 300 ohms using Type 75 Adapter

j. MARKER FREQUENCY RANGES -
2.5 - 5.5 mc fundamental
19 - 50 mc fundamental
54 - 108 mc fundamental
108 - 216 mc harmonic of 54 - 108 mc band
470 - 890 mc harmonics of fundamental frequencies

k. MARKER OUTPUT VOLTAGE RANGES -
2.5 - 5.5 mc range - .2 volt
19 - 50 mc range - .2 volt RMS
54 - 108 mc range - .5 volt RMS
108 - 216 mc range - harmonic of 54 - 108 mc band
470 - 890 mc range - voltage varies - determined by the harmonic used.

m. 4.5 MC CRYSTAL OSCILLATOR - Frequency accuracy, .05%

n. MARKER MODULATION - Variable frequency marker and 4.5 mc crystal oscillator amplitude modulated 30%

p. TUBE COMPLEMENT -

6J6	High and low frequency, fixed frequency oscillator
6J6	FM oscillator
12AT7	Variable frequency marker oscillator
12AU7	Audio oscillator and 4.5 mc crystal oscillator
1X2B	Rectifier
6X4	Rectifier
6143	Voltage regulator

q. SIZE - 13-1/4 inches high, 16-1/4 inches wide, and 8 inches deep

r. WEIGHT - 30 pounds

s. COLOR - Blue Hammertex case with anodized, satin finish panel.

LIST OF ILLUSTRATIONS

FRONT MATTER

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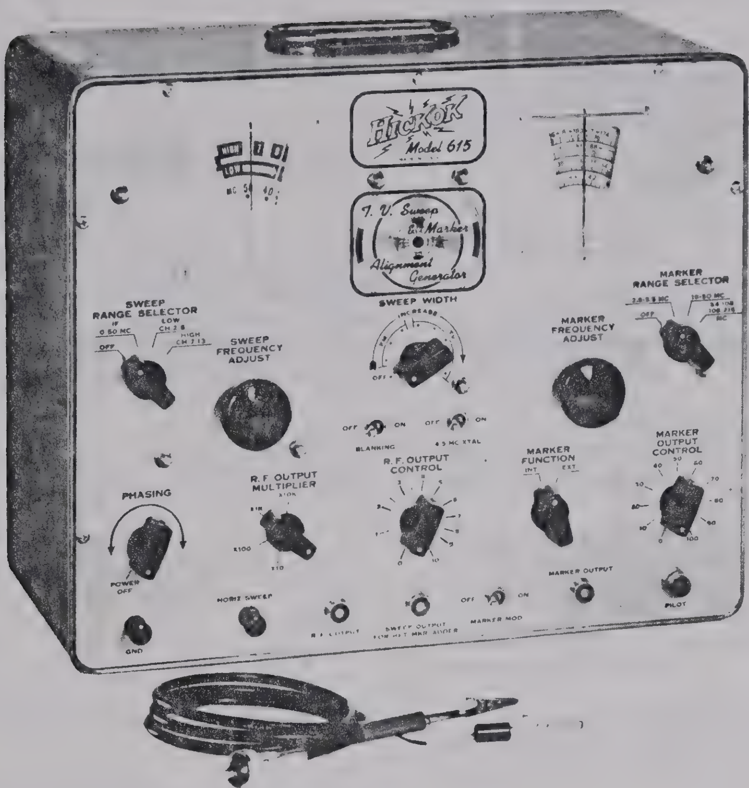

MODEL 615 TV SWEEP AND MARKER ALIGNMENT GENERATOR

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10514 DUPONT AVENUE • CLEVELAND 8, OHIO

PHONE — 541-8060 CABLE — HICKOK, CLEVELAND
TWX — CV 662 WESTERN UNION — KJ

2490-508

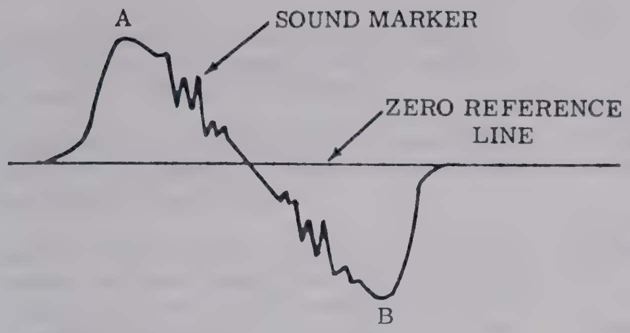


Figure 2-13. Typical Discriminator Response Curve

2-15. FRONT END ALIGNMENT.

The front end response curve must be wide enough to amplify both picture and sound carrier frequencies. Since the picture and sound frequencies are 4.5mc apart, the response curve shall be at least 6mc wide. A typical RF response curve is shown in figure 2-14.

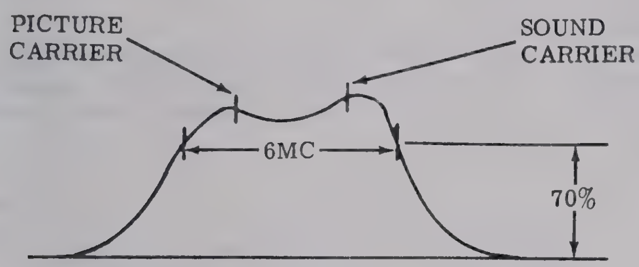


Figure 2-14. Typical RF Response Curve

Lacking specific recommendations from the TV receiver manufacturer as to front end alignment, proceed as follows:

a. Connect the oscilloscope to the test point on the tuner.

b. Connect the generator to the antenna terminals using the Type 75 matching pad, and set up for 300 ohms impedance match.

c. Place a fixed bias on the A. G. C. line of a suggested nominal value of -3 volts dc.

d. Adjust the sweep generator and the TV receiver to the same channel.

e. Adjust the oscilloscope to obtain the RF response curve on the screen.

f. Phase the response curve and turn the blanking ON.

g. Set the marker generator for picture and sound carrier frequencies. This is accomplished by beating the 4.5mc crystal against the picture carrier in the marker generator. The tuner is then aligned so that the picture and sound markers appear within the flat top portion of the response curve for each channel.

2-16. RF LOCAL OSCILLATOR ALIGNMENT.

The local oscillator of a TV receiver must be accurately set so that when the station signal is heterodyned against the local oscillator the difference frequency will be that of the IF frequency of the receiver.

Lacking specific recommendations from the TV receiver manufacturer as to oscillator alignment, proceed as follows:

a. Determine that the tuner, video, and sound IF circuits are properly aligned. This is a prerequisite to any alignment of the local oscillator.

b. If the oscillator has been disabled for the tuner and video IF alignment, restore it to normal operation.

c. Connect the equipment as shown in figure 2-4 for overall IF alignment with this exception. The Model 615 must be connected to the antenna terminals of the TV receiver.

d. Set the TV receiver channel selector to Channel 13 and the fine tuning control to the mechanical center of its range.

e. Set the marker generator to the Channel 13 picture carrier frequency.

f. Set the RF output, marker output, and sweep width controls to the same positions as for overall video IF alignment.

g. Set the SWEEP RANGE SELECTOR to Channel 13. Adjust to center the response curve on the oscilloscope.

h. Adjust the Channel 13 tuning slug or trimmer to place the picture carrier halfway down on the video side of the response curve, or as indicated in the manufacturer's service manual.

i. Continue this procedure for all of the remaining channels. Be certain to set the marker generator and the sweep generator to the correct picture carrier frequency for each channel to which the local oscillator is being aligned.

2-17. FINAL OVERALL ANTENNA-TO-DETECTOR CHECK

After each section has been properly aligned, an overall check shall be made and the video IF frequencies slightly adjusted, if necessary. To accomplish this, proceed as follows:

a. Connect the Model 615 to the antenna of the receiver through the Type 75 matching pad, set for 300 ohms.

b. Connect the oscilloscope to the second detector through the isolation resistor.

c. Set the TV receiver and sweep generator to the same channel frequency.

j. Disable the video IF system of the TV receiver / grounding its input or by biasing it off by means of bias box connected to the AGC test point.

k. Connect the vertical input probe of an oscillo- :ope to point "Z" in figure 2-12. Set the oscilloscope ontrols for maximum vertical gain.

m. Turn ON the TV receiver and adjust oscillo- cope to display the audio signal from the Model 615 ıarker. If necessary, advance the MARKER OUTPUT ontrol to a higher setting but no more than necessary) provide a usable display on the oscilloscope.

n. Adjust the sound IF tuned circuits of the TV eceiver to peak the audio signal on the oscilloscope. ›o not adjust the quadrature coil.

p. Advance the MARKER OUTPUT control to the oint where the audio wave form begins to distort, then et the MARKER OUTPUT control just below the dis- ortion point.

q. Tune the quadrature coil for a null point in he audio signal. This null is very sharp and will be ound between the two peaks.

2-14. DISCRIMINATOR ALIGNMENT.

Lacking specific recommendations from the TV manufacturer as to discriminator alignment and after the sound IF stages have been properly aligned the discriminator circuit may be visually adjusted as follows:

a. Connect the generator to the grid of the limiter stage preceding the discriminator.

b. Set the sweep and marker generators to the sound IF frequency. Set the SWEEP WIDTH control to the middle of the FM segment. Set the marker generator to the sound IF frequency. This set-up will display the discriminator response curve.

c. Connect the oscilloscope with a series isolation resistor of approximately 27, 000 ohms to point marked "Y" on the schematic wiring diagram which most closely approximates that of the TV receiver being serviced. See figures 2-7 or 2-8. Phase the response curve and turn blanking ON.

d. Adjust the primary and secondary of the discriminator transformer for maximum amplitude, maximum linearity between points "A" and "B", and symmetry above and below the zero reference line with the marker in the center as shown in figure 2-13.

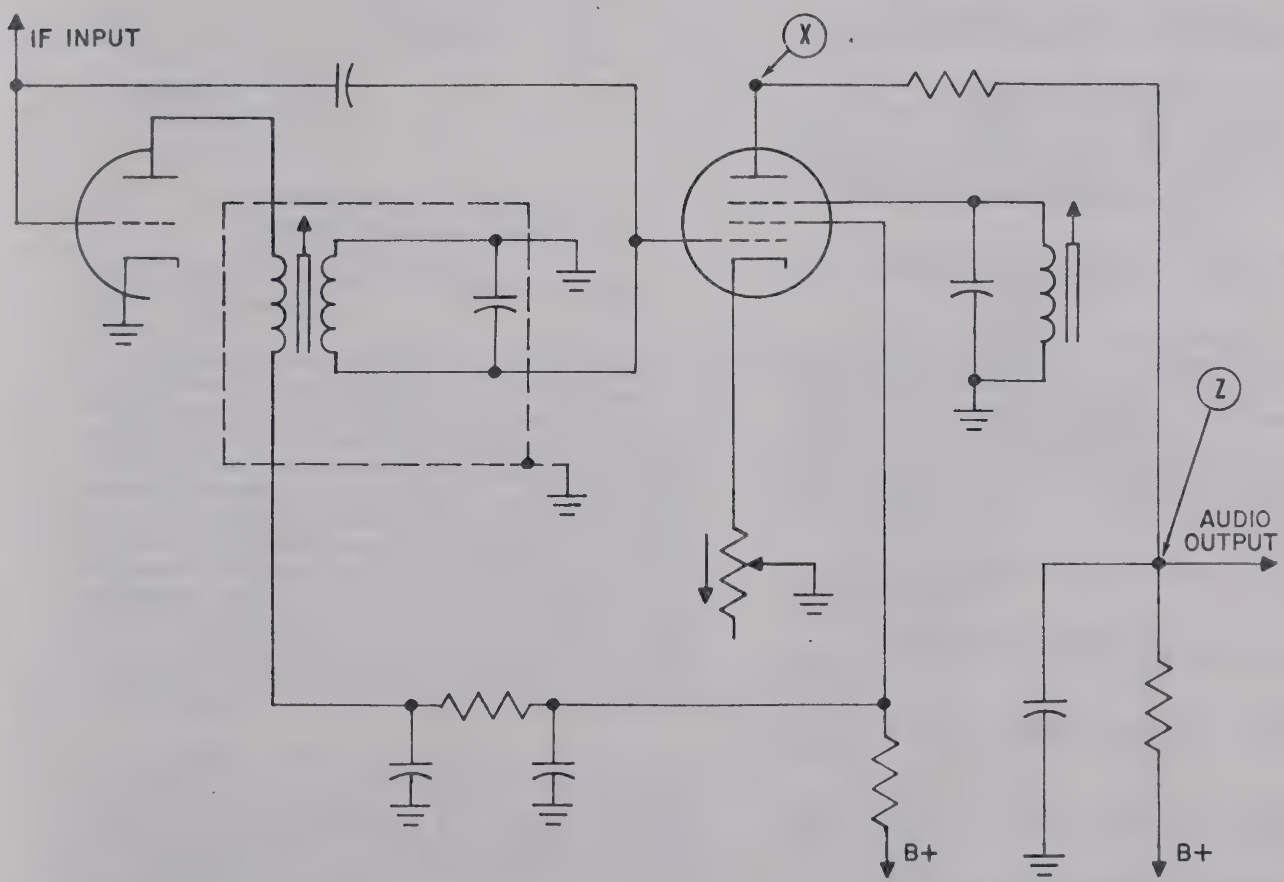


Figure 2-12. Typical Sound IF Amplifier and Quadrature Detector

d. TYPICAL VIDEO IF RESPONSE CURVES.

Most manufacturers service manuals show a video IF response curve for each TV receiver. Lacking a recommendation from the manufacturer, figures 2-9 and 2-10 illustrate typical curves - one for each of the two systems.

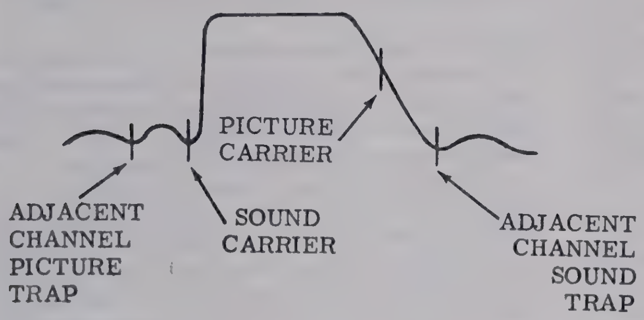


Figure 2-9. Typical Dual Channel Video IF Response Curve

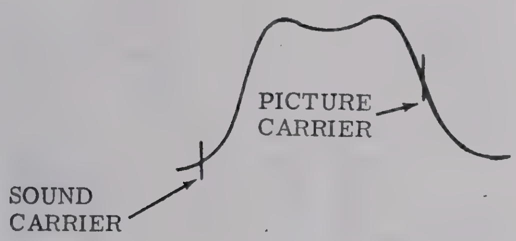


Figure 2-10. Typical Intercarrier Video IF Response Curve

2-12. SOUND IF ALIGNMENT (Ratio Detector or Discriminator)

Alignment of the sound IF stages of a TV receiver is in general, accomplished in a manner similar to the alignment of a conventional FM receiver. If the sound IF stages are badly out of alignment, the sound section of the receiver shall first be peaked with the marker generator and a VTVM, and then visually touched-up with the Model 615 and an oscilloscope. This will save considerable time in alignment. There are several methods that may be employed for this alignment; however, the best method is that one recommended by the manufacturer of the TV receiver. Lacking a recommendation from the manufacturer (for ratio detector or discriminator type of system), proceed as follows:

a. Connect the R. F. OUTPUT of the Model 615 to the input of the sound IF amplifier. Avoid loading the input circuit by coupling the generator to it through a small value capacitor. Usually sufficient coupling can be attained by clipping the generator lead onto the insulation of the input circuit.

b. Connect the oscilloscope with a series isolation resistor of 10,000 ohms to the point marked "X" on the typical wiring diagram which most closely approximates that of the TV receiver being serviced. See figures 2-7 and 2-8.

c. Adjust the sweep generator to the sound IF frequency. Set SWEEP WIDTH control to the middle of the FM segment. Set the marker generator to the sound IF frequency. This set-up will display the sound IF response curve on the oscilloscope.

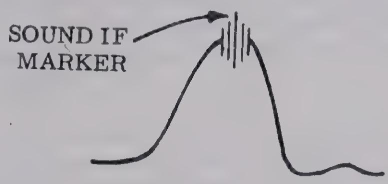


Figure 2-11. Typical Sound IF Response Curve

d. Adjust the IF trimmers or slugs for maximum amplitude and symmetry of pattern about the marker as shown in figure 2-11.

2-13. QUADRATURE SOUND SYSTEM ALIGNMENT.

Lacking specific recommendations from the TV receiver manufacturer, proceed as follows:

a. It is imperative that a weak signal always be used for quadrature sound detector alignment. A weak signal keeps the signal below the limiting threshold of the detector and thus prevents a broad and ambiguous response to alignment adjustments.

b. Connect the Model 615 output cable to the MARKER OUTPUT connector.

c. Clip the Model 615 output leads to the input of the sound IF system. Do not connect the output leads directly to the input of the tuned circuit of the sound IF stage. Clip onto the insulation of the sound takeoff-lead or use a 1.0 pf capacitor. If the sound takeoff circuit is in the plate circuit of the video amplifier, the Model 615 may be connected to the grid of the video amplifier.

d. Set MARKER FUNCTION control in the INT (internal) position.

e. Set MARKER RANGE SELECTOR in the OFF position.

f. Set the MARKER OUTPUT control in the 30 position.

g. Place the 4.5 MC XTAL switch in the ON position.

h. Place the MARKER MOD. (modulator) switch in the ON position.

i. Place the SWEEP RANGE SELECTOR in the OFF position.

Final touch-up adjustments are made by removing the VTVM and replacing with the oscilloscope (as shown in figure 2-4) for overall video alignment. Analyze the visual response curve and make final touch-up adjustments to obtain response curve shown in manufacturer's service manual.

c. STAGE-BY-STAGE VIDEO IF ALIGNMENT.

In this method, the manufacturer usually specifies where to connect the generator and the oscilloscope as each stage is being individually aligned. The oscilloscope is usually connected to the second detector and remains there throughout the complete video IF alignment. The RF input is connected through a suitable RF coupling condenser to the grid of the last video IF stage. The generator cable must be terminated. Avoid excessive signal from the signal generator for it can cause overloading of the receiver circuits. To determine that there is no overloading and that the response curve is a true representation, turn the sweep generator output to zero. Gradually increase the output until a response is obtained. Further increase of the sweep output should not change the response curve except in amplitude. If the response curve changes in configuration, such as flattening at the top or dropping below the base line at the bottom, decrease the sweep output to restore the proper configuration. The oscilloscope gain should be run as high as possible to maintain a usable pattern, thus requiring a lower output from the sweep generator and less chance of overload. This set-up will display on the oscilloscope the response curve of the last video tuned circuit. Adjust this last video IF stage according to the manufacturer's instructions.

The next step is to move the RF cable to the grid of the preceding IF stage and adjust to the manufacturer's instructions. This process is continued on back to the mixer stage. In this manner, each stage is individually aligned according to the manufacturer's instructions.

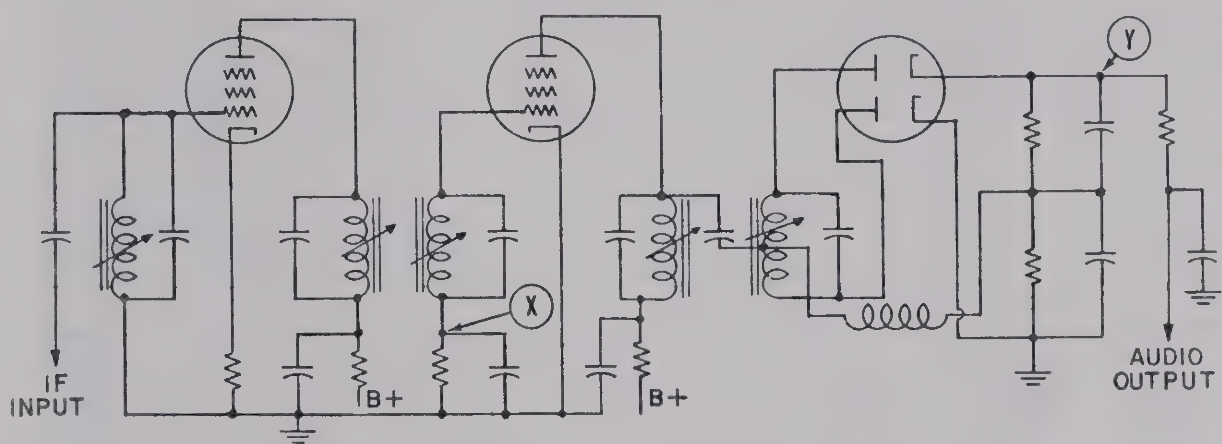


Figure 2-7. Typical Sound IF Amplifiers and Foster-Seeley Discriminator

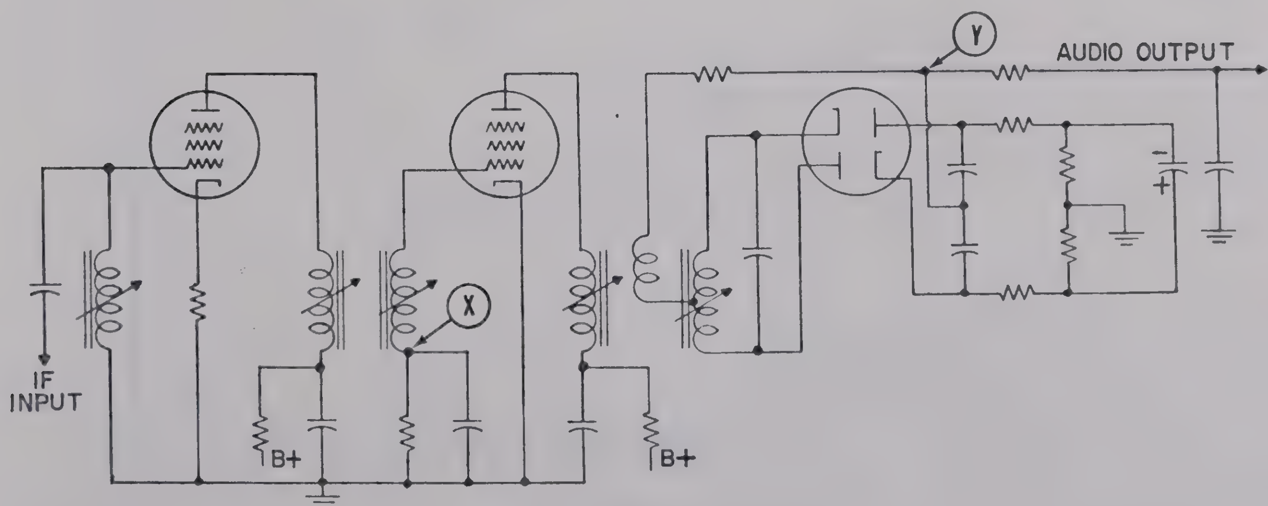


Figure 2-8. Typical Sound IF Amplifiers and Ratio Detector

and that the response curve is a true representation, turn the sweep generator output to zero. Gradually increase the output until a response is obtained. Further increase of the sweep output should not change the response curve except in amplitude. If the response curve changes in configuration, such as flattening at the top or dropping below the base line at the bottom, decrease the sweep output to restore the proper configuration. The oscilloscope gain should be run as high as possible to maintain a usable pattern, thus requiring a lower output from the sweep generator and less chance of overload.

b. STAGGER-TUNED VIDEO IF ALIGNMENT.

In this method an unswept (fixed frequency) signal from the generator is used. The unswept signal can be obtained by turning the SWEEP WIDTH control of the generator to the OFF position and connecting the RF cable to the MARKER OUTPUT jack. This method uses a vacuum tube voltmeter such as the Hickok Model 470 or the 209 series, or equal, instead of an oscilloscope. Connect the RF cable from the generator to the mixer tube shield. Pull the shield away from the ground, but let it remain on the tube as shown in figure 2-5.

Connect a vacuum tube voltmeter to the second detector diode load resistor of the TV receiver and adjust the voltmeter to indicate dc volts. It may be advisable to disable the local oscillator of the TV receiver. See paragraph 2-8. Place a fixed bias on the A. G. C. line. Avoid excessive signal from the signal generator for it can cause overloading of the receiver circuits. Use only sufficient generator output to produce the lowest possible usable response on the lowest range of the VTVM (-2 to -3 volts is usually a typical value of the detected signal). Set the generator to the proper frequency and peak each stage for maximum indication on the meter according to the manufacturer's video IF alignment instructions. See figure 2-6.

For trap adjustments, set the generator to the manufacturer's specified trap frequencies and adjust the individual traps for minimum indication on the meter.

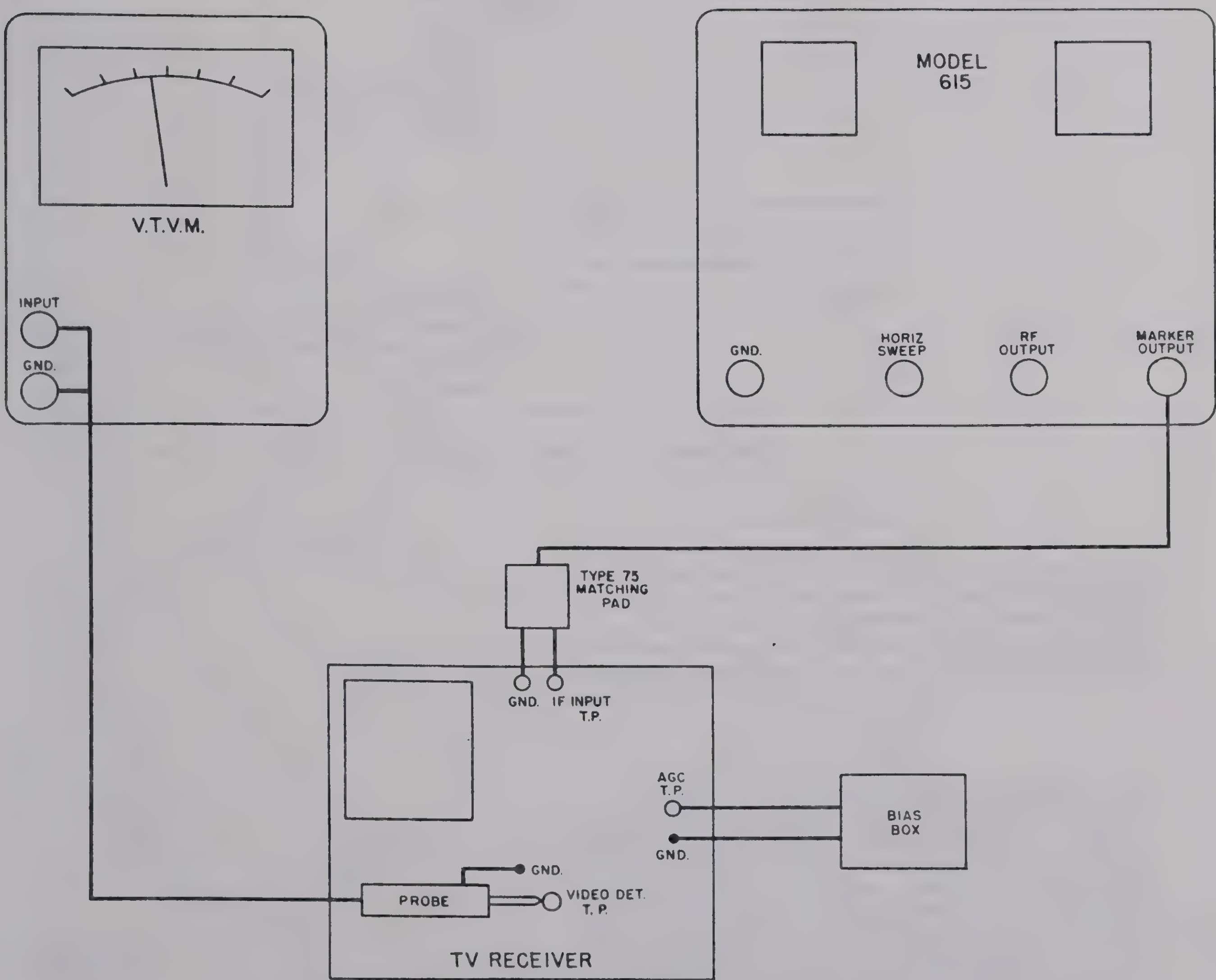


Figure 2-6. Typical Stagger-tuned Video IF Alignment Set-up

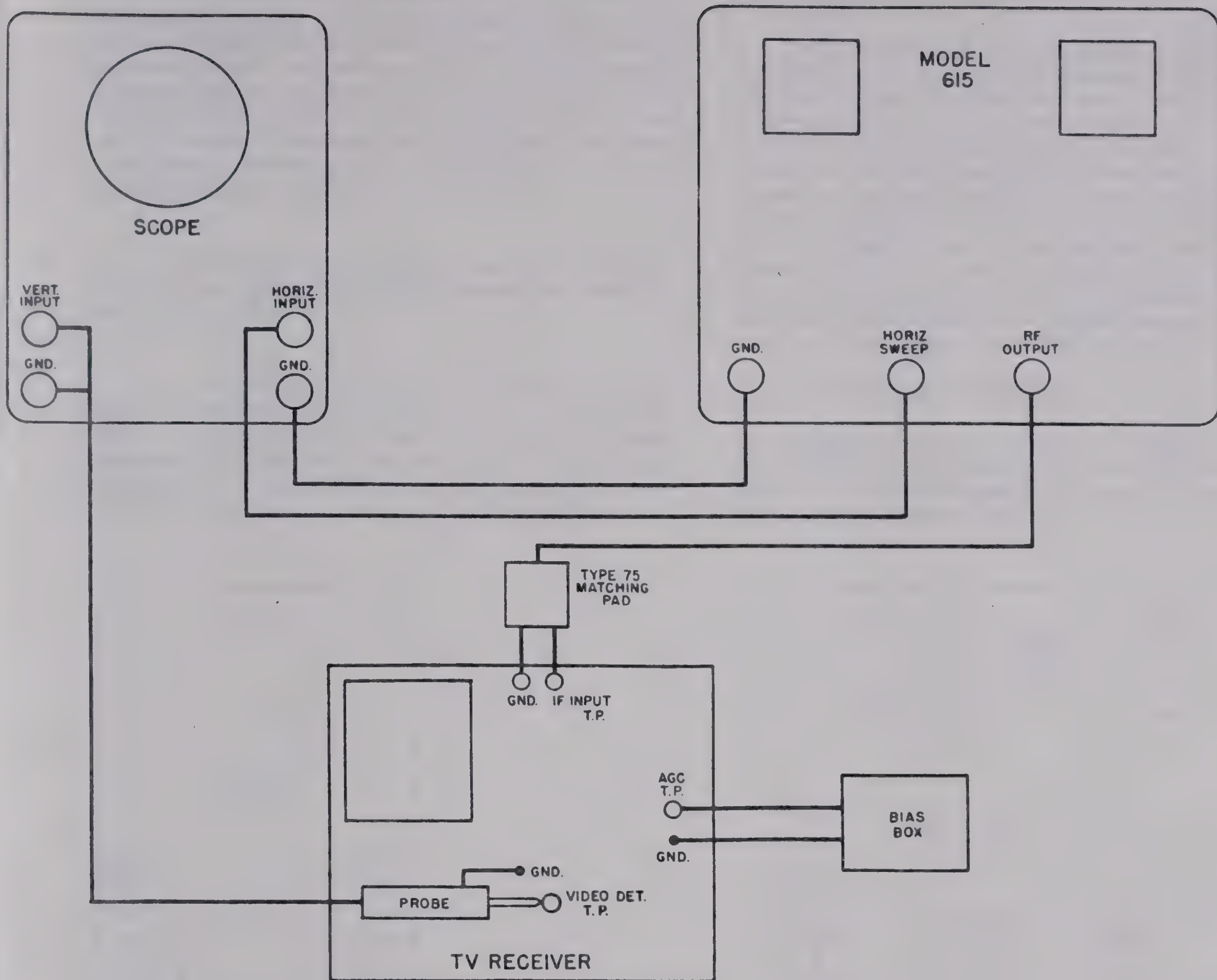


Figure 2-4. Typical Video IF Alignment Set-up

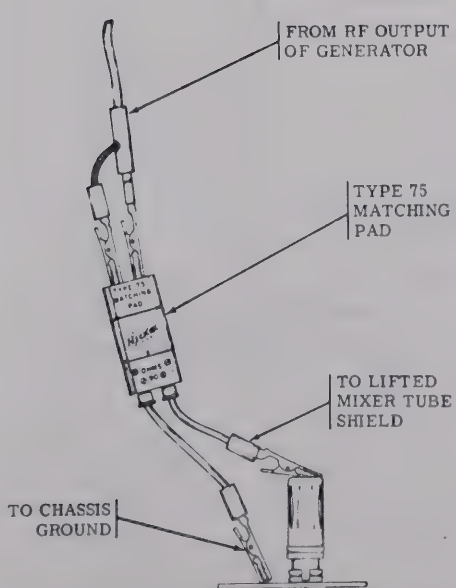


Figure 2-5. Hook-up with Mixer Tube Shield

2-11. VIDEO IF ALIGNMENT.

Various manufacturers recommend various methods of alignment of the video IF of their TV receivers. Be guided by their recommendations. Generally, their recommendations will involve one of the following methods. See figure 2-4 for a typical IF alignment set-up.

a. VIDEO IF ALIGNMENT.

In this method the oscilloscope is usually connected to the second detector and remains at that point throughout the complete video IF alignment. The RF output of the sweep generator is connected through a suitable coupling condenser to the input of the first video IF stage. A convenient method of coupling is shown in figure 2-5. This will display the overall response curve of the entire video IF section on the oscilloscope screen. The generator cable must be terminated. Avoid excessive signal from the signal generator for it can cause overloading of the receiver circuits. To determine that there is no overloading

If the local oscillator is disabled, either by removing the oscillator tube or by cutting the plate pin on the tube, a slight error in video alignment may result; however, this is not serious, for in the final overall alignment check the first IF stage can be retouched to produce the desired overall response curve. The slight change in response with or without the local oscillator in operation is due to either one or the other of the following conditions:

a. With the oscillator tube removed the distributed capacity of the circuit is changed and tends to detune the circuit.

b. With the plate pin of the oscillator cut to disable the oscillator, the amount of bias developed at the mixer grid will change due to the presence or absence of RF from the local oscillator. This change in bias level of the mixer tube tends to detune the plate tank circuit which is essentially the first IF stage.

2-9. OPERATING PROCEDURE.

See paragraph 2-1 before attempting to operate the generator. Connect the generator to the power source. Allow 20 minutes warm-up time to electrically stabilize the generator. Alignment of the receiver is usually a step-by-step operation. The sequence of the steps may vary; therefore, no attempt should be made to align a TV receiver without a copy of the manufacturer's service manual for the particular set being aligned. The manufacturer's service manual shows such items as alignment frequencies to be used and the test point (T. P.) locations. These test points are sometimes exposed pig-tails as they are used in production and final testing.

2-10. TV TUNER ALIGNMENT.

Alignment of the TV tuner is usually the first step in aligning a TV receiver. Be guided by the manufacturer's service manual. See figure 2-3 for a typical TV tuner alignment set-up.

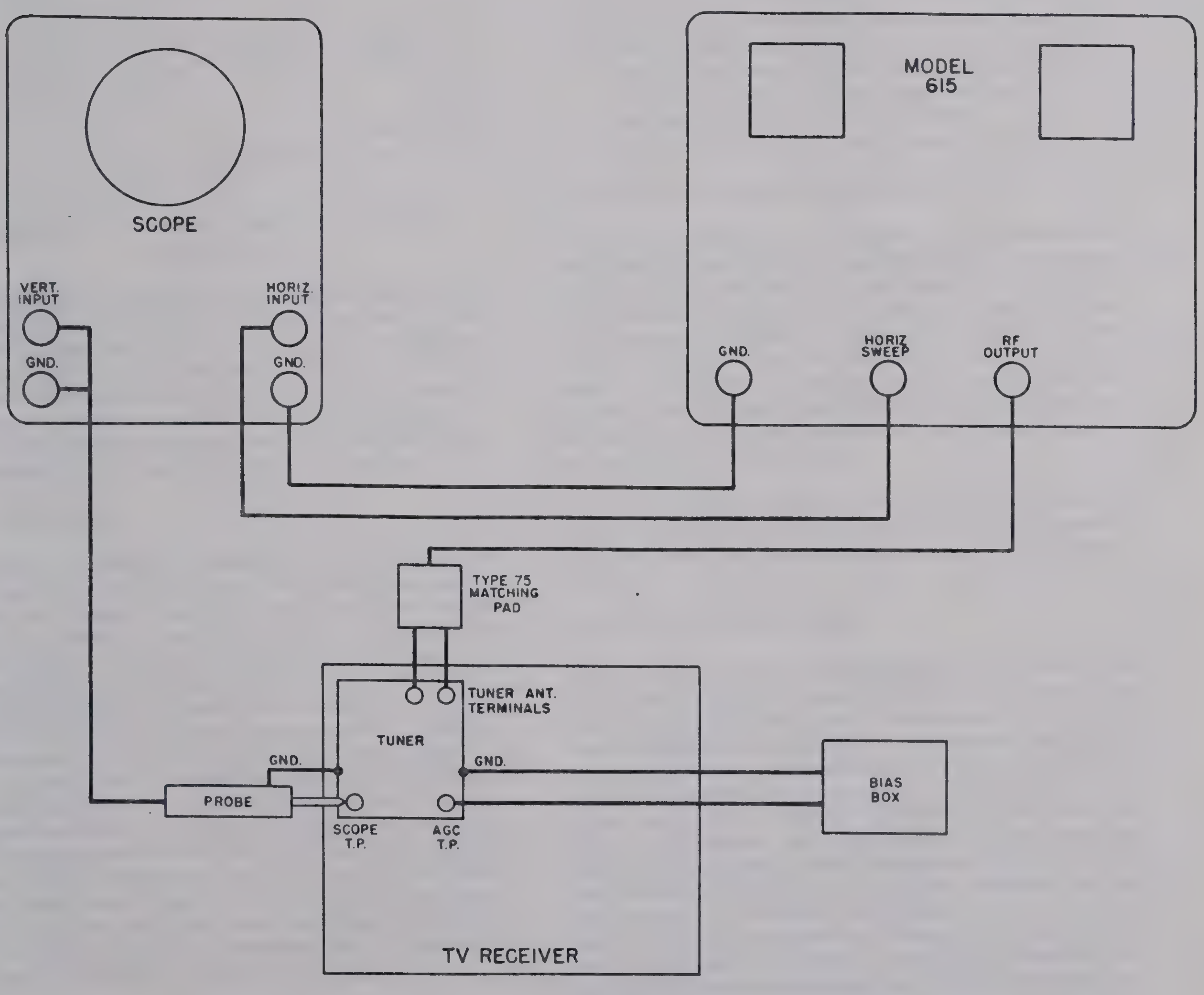


Figure 2-3. Typical TV Tuner Alignment Set-up

2-3. GENERAL.

Alignment procedures will vary somewhat between sets of the same manufacture, as well as between manufacturers. The manufacturer's alignment instructions should be followed at all times. The Model 615 is versatile and is compatible with any TV. The following generalities are common to most alignment procedures.

2-4. PROPER TERMINATION OF RF OUTPUT CABLE.

The RF output cable of the Model 615 has a characteristic impedance of 90 ohms and therefore must be terminated with 90 ohms. This can either be done by using the Type 75 Adapter, or a 90 ohm non-inductive resistor. For a 300 ohm antenna connection, the Type 75 Adapter can be used, or as an alternative, the resistive network shown in figure 2-2, may be used.

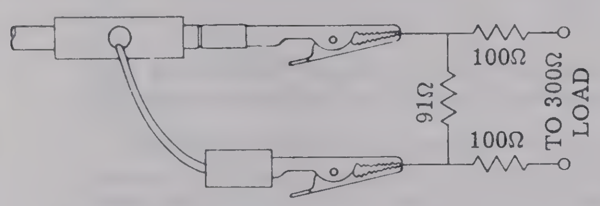


Figure 2-2. Resistive Network for 300 Ohm Termination

If the cable is not terminated properly, standing waves will result and cause an error in alignment. To determine if standing waves are present, the operator can, by clamping his hand around the cable, note any changes in the response curve as the hand is slid along the cable. If the response curve does change, the cable is not properly terminated. Before proceeding in alignment, this condition must be remedied.

2-5. FIXED BIAS.

Sometimes a changing response is due to inadequate fixed bias when the RF level from the generator is varied. In a case of no fixed bias, it may be caused by the bias level in the TV receiver varying with the RF level input. Due to the "Miller Effect", the input capacity of a tube will vary with bias variation. The input capacity of an RF or IF amplifier is essentially across the grid or plate tuned circuit; consequently, the overall response curve will change. For this reason, the use of fixed bias is recommended, using the value specified in the manufacturer's instructions. Lacking a recommendation from the manufacturer this value must be determined for best overall performance under average field conditions. In a strong signal area higher fixed bias should be used, and conversely, fringe areas require a smaller fixed bias. The exact value is best determined experimentally, dependent upon the TV receiver and field conditions.

One method of doing this is to connect the antenna to another receiver of the same make and tune in a station in the same area. Then check with a vacuum tube voltmeter the actual value of bias developed on the A. G. C. bus. The resultant value of fixed bias should be used for alignment.

> NOTE
>
> When using this method, the TV set must be in fairly normal condition or an error in alignment will result.

2-6. GENERATOR RF LEVEL.

The RF level at which the TV receiver is aligned is an important factor in proper servicing. With a given fixed bias, adjust the RF level of the generator to the DC or AC voltage at the second detector as specified by the manufacturer of the particular receiver being serviced. This establishes the RF input level.

> IMPORTANT
>
> In any case, never use an extremely high level of RF input where the response curve shows flattening at the top, or any other distortion that would be caused by overloading of the video IF amplifiers.

2-7. OSCILLOSCOPE CONNECTION.

The point at which the oscilloscope is connected is specified by the receiver manufacturer. Put an isolation resistor (20, 000 to 50, 000 ohms) in series with the oscilloscope cable. This value is not critical. This serves to isolate the cable and the oscilloscope from the TV circuit. It also serves as a low pass filter to sharpen the marker pip. If the marker pip is still fairly broad, the addition of a 500 mmf condenser across the oscilloscope vertical input terminals will serve to sharpen the pip.

On 4. 5 mc IF ground both ends of the outer shield of the oscilloscope cable, one end at the oscilloscope and the other end to a suitable ground in the TV receiver.

2-8. LOCAL OSCILLATOR.

Some manufacturers recommend disabling the local oscillator in the TV receivers, others do not. Be guided by the manufacturer's recommendation. If the local oscillator is not disabled, spurious or additional response curves may be found in setting-up for an IF alignment where the generator is connected to the mixer tube shield. This is caused by the RF from the sweep and marker generators heterodyning with the local oscillator, thus producing sum and different beats which show in the form of spurious response curves and markers. To avoid this, switch the channel selector of the TV receiver to a channel where no spurious responses are present. Use this channel for IF alignment. The channels on which spurious responses are present vary with the make and design of the receiver.

SECTION 2

OPERATING INSTRUCTIONS

2-1. INTRODUCTION.

The Model 615 TV Sweep and Marker Alignment Generator is designed to operate on either 115 volts or 220 volts, 50 or 60 cycle current. It is shipped from the factory to operate on 115 volts unless ordered otherwise. If 230 volt operation is desired, it is necessary to change the wiring of the power transformer (T1) from a parallel to a series hook-up. See Schematic Wiring Diagram in the back of this manual. Do NOT connect the Model 615 to ANY power source until the voltage of the power source has been determined.

2-2. FRONT PANEL CONTROLS AND CONNECTORS.

The purpose and function of the front panel controls and connectors (See figure 2-1) are as follows:

SWEEP FREQUENCY DIAL - Provides three scales: 0-50 mc, channels 2 to 6, and 7 to 13, corresponding to position of SWEEP RANGE SELECTOR. Also provides for channels 14 to 83. See paragraph 2-18.

MARKER FREQUENCY DIAL - Provides four scales: 2.5 to 5.5 mc, 19 to 50 mc, 54 to 108 mc, and 108 to 216 mc (harmonic) corresponding to position of MARKER RANGE SELECTOR. Also provides harmonics used for UHF channels.

4.5 MC XTAL OFF-ON - Off-on toggle switch, in the ON position, provides a 4.5 mc marker.

MARKER FREQUENCY ADJUST - Continuously variable control, selects desired frequency as indicated on MARKER FREQUENCY DIAL - used in conjunction with MARKER RANGE SELECTOR.

MARKER RANGE SELECTOR - Four position rotary switch - OFF, 2.5 to 5.5 mc, 19 to 50 mc, and 54 to 108 mc (108 to 216 mc harmonic). Operates in conjunction with MARKER FREQUENCY ADJUST.

R. F. OUTPUT CONTROL - Continuously variable control - vernier attenuator of RF output voltage available at the R. F. OUTPUT connector.

MARKER FUNCTION-INT.-EXT. - Two position rotary switch, switches marker oscillator output from internal mixing to MARKER OUTPUT connector - used in conjunction with a good heterodyne marker adder such as Hickok Heterodyne Marker Adder Model 691, or equal.

MARKER OUTPUT CONTROL - Continuously variable control - attenuates marker amplitude.

PILOT LIGHT - Indicates that the unit is connected to power source and that the power is on.

MARKER OUTPUT - Mic connector - marker RF output voltage is available at this connector when MARKER FUNCTION-INT.-EXT. switch is in EXT. (external) position.

MARKER MOD. OFF-ON - Two position toggle switch - provides amplitude modulation of the marker signal when the switch is in the ON position.

SWEEP OUTPUT FOR HET. MKR. ADDER - Mic connector - provides rectified or base line markers when used in conjunction with a good heterodyne marker adder such as Hickok Model 691, or equal.

R. F. OUTPUT - Mic connector - provides an RF output connection.

HORIZ SWEEP - Screw cap binding post - horizontal sweep voltage output for oscilloscope.

GND - Screw cap binding post - Provides for ground bonding of TV receiver, other test equipment, metal benches, etc.

R. F. OUTPUT MULTIPLIER - Five position rotary switch - provides multipliers of X1, X10, X100, X1K, and X10K of the RF output voltage.

PHASING-POWER OFF - Continuously variable and off control - provides phasing adjustment of oscilloscope horizontal sweep voltage available at HORIZ SWEEP binding post - power off at full counterclockwise position.

BLANKING OFF-ON - Two position toggle switch provides a zero reference line when switch is in the ON position.

SWEEP RANGE SELECTOR - Four position rotary switch - Selects sweep operating ranges and sweep off (OFF, IF 0-50 MC, channels LOW CH 2-6, and channels HIGH CH 7-13). Also selects UHF channels 14-83. Operates in conjunction with SWEEP FREQUENCY ADJUST.

SWEEP FREQUENCY ADJUST - Continuously variable control, selects desired frequency as indicated on sweep frequency dial - used in conjunction with SWEEP RANGE SELECTOR.

SWEEP WIDTH - Nine position rotary switch, including an OFF position - Adjusts sweep width of FM signal from 0 to 15 mc, ± 3 mc.

SECTION 5

PARTS LIST

5-1. INTRODUCTION.

Reference designations are assigned to identify all parts of the Model 615 TV Sweep and Marker Alignment Generator. These designations are used in the parts list as well as on the schematic wiring diagram. The letter prefix of a reference designation indicates the kind of part -- resistor, capacitor, electron tube, etc. The number differentiates between parts of the same group.

Ref. Desig.	Name and Description	Hickok Part No.	Price Each
C101	CAPACITOR: 1000 uuf, 20%, feed thru	3110-50	.30
C102	Same as C101		
C103	Same as C101		
C104	Same as C101		
C105	CAPACITOR, TRIMMER: 1-3.5 uuf, zero temp coeff.	3115-7	1.25
C106	CAPACITOR, CERAMIC: .005 uf, -0 +100%, disc type	3110-7	.30
C107	Same as C101		
C108	Same as C101		
C109	Same as C101		
C110	CAPACITOR, CERAMIC: 100 uuf, 10%, 2KV	3110-67	.35
C111	CAPACITOR, CERAMIC: 1.5-7 uuf, zero temp. coeff.	3115-12	.90
C112	Same as C105		
C113	CAPACITOR, CERAMIC: 15 uuf, 10%, 500V, zero temp. coeff.	3110-4	.30
C114	Same as C113		
C115	CAPACITOR, TRIMMER: 2.5-13 uuf, NPO	3115-9	1.25
C116	Same as C111		
C117A, B	CAPACITOR, VARIABLE	3120-31	5.25
C118	Same as C111		
C119	CAPACITOR, CERAMIC: 50 uuf (1/2 uuf), 0 temp. coeff.	3110-1	.30
C120	Same as C113		
C121	Same as C101		
C122	Same as C101		
C123	CAPACITOR, CERAMIC: 68 uuf, 10%, 27KVW	3110-63	.35
C124	CAPACITOR, TRIMMER: 3-12 uuf, zero temp. coeff.	3115-10	.90
C125	Same as C124		
C126	CAPACITOR, CERAMIC: 1000 uuf	3110-12	.30
C127	CAPACITOR: 500 uuf, GMV, HV feed thru	3110-51	1.00
C128	Same as C101		

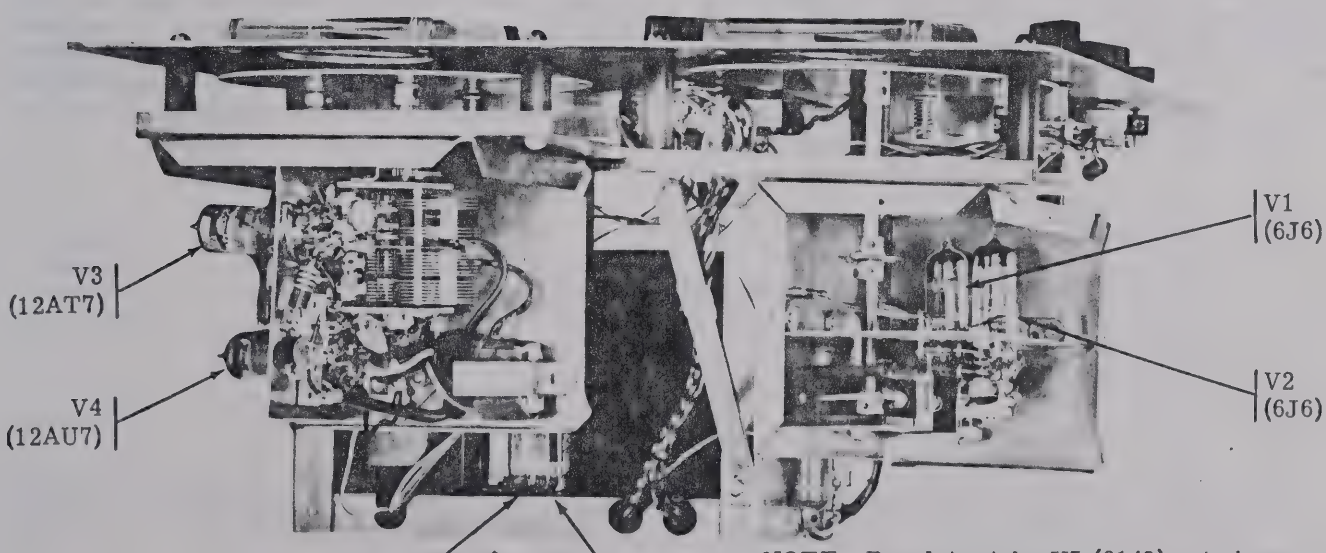
SECTION 4

MAINTENANCE

4-1. GENERAL.

The Model 615 is built in accordance with sound engineering principles, by skilled personnel using quality components. Normally the replacement of tubes or fuses should be the only field maintenance necessary. Should the need arise for more extensive maintenance, it is suggested that the factory be contacted with regard to the nature of the trouble, and, if necessary, the unit be returned to the factory or an authorized Hickok repair station for inspection and service. The block diagram (figure 3-1), the tube complement and location of tubes (figure 4-1), and the schematic wiring diagram in back of manual will aid in routine maintenance.

> WARNING
>
> Care must be exercised when working with the Model 615 when case is removed from chassis as high and dangerous voltages are present.



NOTE: Regulator tube V5 (6143) not shown - mounted on inside of power supply housing - accessible only from bottom of unit.

Figure 4-1. Tube Complement and Location of Tubes (Shields Removed for Clarity)

SECTION 3

THEORY OF OPERATION

3-1. GENERAL.

A working knowledge of the theory of operation of the frequency outputs of the Model 615 enables the operator to utilize the full versatility of this unit. To aid the operator a block diagram (figure 3-1) and a schematic wiring diagram (back of manual) are provided. The various outputs are generated as follows:

3-2. POWER SUPPLY.

The power supply consists of a transformer, rectifiers, and filter network. This is used to supply B+, filament voltages, etc., for the entire instrument. The power consumption is approximately 25 watts.

3-3. SWEEP SECTION.

The sweep section consists of an FM oscillator, two fixed oscillators, and a mixer.

a. FM OSCILLATOR.

The FM oscillator generates a zero to 15mc FM sweep and is continuously variable on fundamentals over the range of 175 mc to 225 mc which provides coverage of Channels 7 through 13. An electronic method of varying the reactance is employed. This variable reactance is across the oscillator tank circuit, hence, frequency modulation is produced.

b. 225 MC FIXED OSCILLATOR.

The 225 mc fixed oscillator is used to heterodyne against the FM sweep oscillator to produce the difference frequency output of zero to 50mc. This output is flat from 10 kc to 50 mc and may be used to sweep video amplifiers, as well as IF amplifiers.

c. 275 MC FIXED OSCILLATOR.

The 275 mc fixed oscillator is used to heterodyne against the FM sweep oscillator to produce a difference frequency output of 50 to 100mc which is used for alignment of Channels 2 through 6.

d. MIXER.

This efficient mixer using 1N72 germanium diodes is employed to obtain heterodyned outputs as shown in table 3-1.

OUTPUT FREQUENCIES	SWEEP OSC. 175-225 MC	FIXED OSC. 225 MC	FIXED OSC. 275 MC
0-50 MC FM	ON	ON	OFF
50-100 MC FM	ON	OFF	ON
175-225 MC FM	ON	OFF	OFF

Table 3-1. Heterodyned Outputs from Mixer

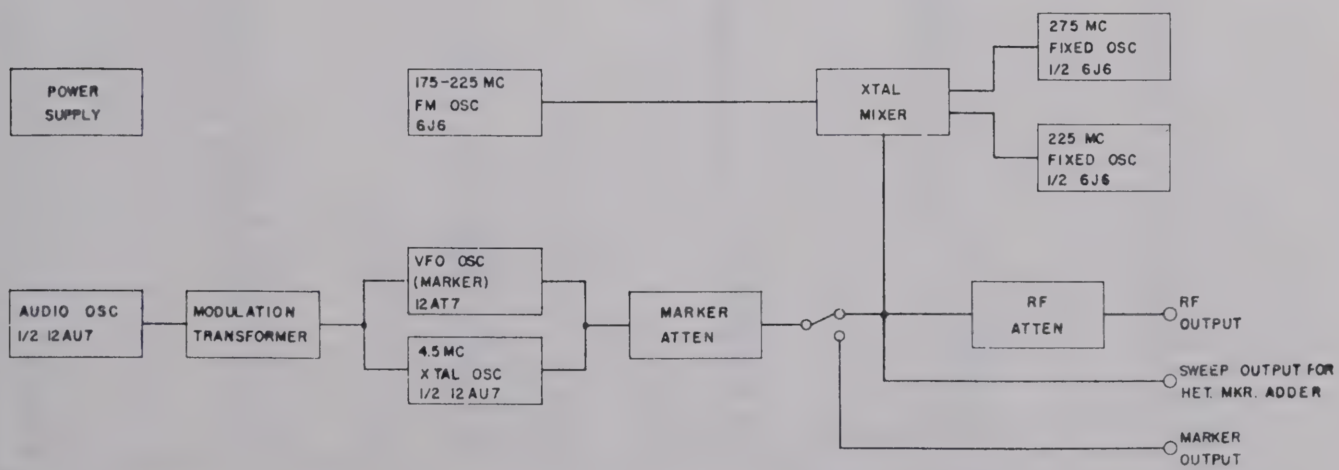


Figure 3-1. Block Diagram of Model 615

d. Set the marker generator for picture and und markers.

e. Adjust the oscilloscope to obtain the response rve on the screen. If the TV receiver is properly igned, the response curve should be identical, or ry similar, to the video IF response curve.

f. With the oscillator fine tuning control of the V receiver in the mechanical center of its range, the cture and sound markers should be located as shown figures 2-9 and 2-10.

g. If the response curve changes shape from hannel to channel, it is an indication that the front nd is improperly aligned.

h. If the response curve has a slight tilt or ir-egularity, but is constant on all channels, it is an ndication of improper video IF alignment. In this ase the video IF can be touched-up for the desired esponse.

i. As a final check, the RF attenuators on the sweep and marker generators are reduced to a very low RF level. This will necessitate increasing the vertical gain control of the oscilloscope. The response curve is then checked for response with weak signals.

2-18. UHF CHANNEL ALIGNMENT.

Alignment procedures for the UHF channels are the same as for VHF channels with the exception of the positioning of the dials and controls of the Model 615.

Channels 14 through 20 require the SWEEP RANGE SELECTOR be placed in the LOW CH 2-6 position. Channels 21 through 83 require the SWEEP RANGE SELECTOR be placed in the HIGH CH 7-13 position.

Table 2-1 shows the sweep frequency dial settings for the various frequencies of all UHF channels. These are controlled by the SWEEP FREQUENCY ADJUST.

Table 2-1 also shows the marker frequency dial settings for the corresponding UHF channels. These are controlled by the MARKER RANGE SELECTOR and the MARKER FREQUENCY ADJUST controls.

UHF CHANNEL	SWEEP FREQ. DIAL SET.	MARKER FREQ.
14	26-31	78.54
15	17-21	79.54
16	17-21	80.54
17	10-15	81.54
18	6-10	82.54
19	0-5	83.54
20	0-5	84.54
21	48-50 +	73.32
22	48-50 +	74.18
23	48-50 +	75.03
24	45-48	75.89
25	42-45	76.75
26	40-42	77.61
27	40-42	78.46
28	40-42	79.32
29	40-42	80.18
30	32-39	81.04
31	32-39	81.89
32	28-31	82.75
33	28-31	83.61
34	28-31	84.46
35	20-27	85.32
36	20-27	86.18
37	20-27	87.04
38	15-20	87.89
39	15-20	88.75
40	15-20	89.61
41	9-14	70.36
42	9-14	71.02
43	9-14	71.69
44	0-10	72.36
45	0-10	73.03
46	0-10	73.69
47	0-10	74.36
48	50 +	84.41
49	50 +	85.16
50	48-50 +	85.91
51	48-50 +	86.66
52	48-50	87.41
53	45-48	88.16
54	45-48	88.91
55	43-45	89.66
56	43-45	90.41
57	40-42	91.16
58	40-42	91.91
59	39-40	92.66
60	32-39	93.41
61	32-39	94.16
62	32-39	94.91
63	31-32	95.66
64	28-31	96.41
65	28-31	97.16
66	27-28	97.91
67	27-28	98.66
68	20-27	99.41
69	20-27	89.03
70	20-27	89.69
71	20	90.36
72	15-20	91.03
73	15-20	91.69
74	15-20	92.36
75	15-20	93.03
76	9-14	93.69
77	9-14	94.36
78	9-14	95.03
79	0-10	95.69
80	0-10	96.36
81	0-10	97.03
82	0-10	97.69
83	0-10	98.36

Table 2-1. Dial and Control Settings for UHF Channel Alignment

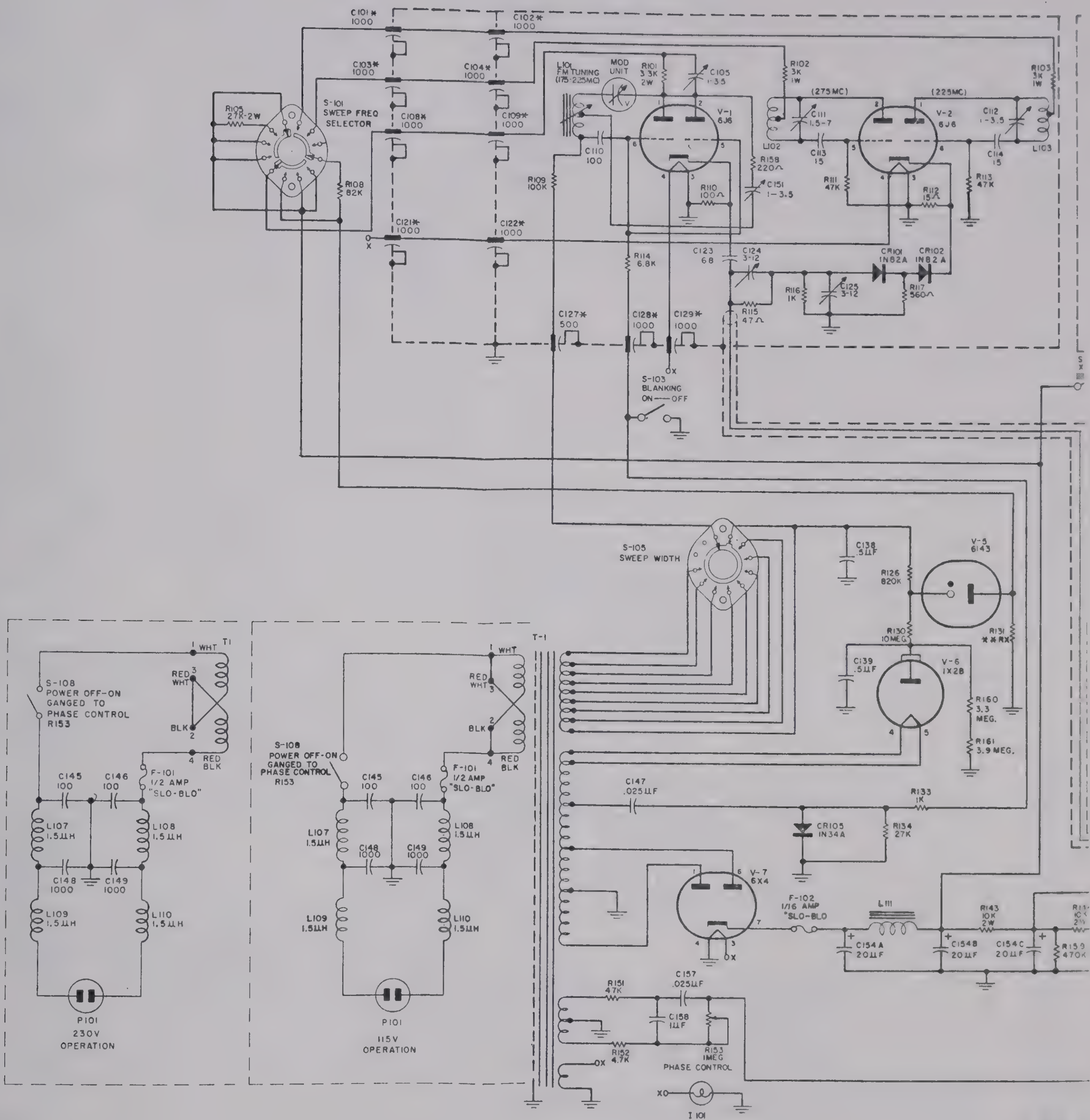
Ref. Desig.	Name and Description	Hickok Part No.	Price Each
C129	Same as C101		
C130	Same as C101		
C131	CAPACITOR, METALLIZED: .05 uf, 400 volts	3105-103	.20
C132	Same as C101		
C133	CAPACITOR, CERAMIC: 500 uuf, 600V	3110-42	.30
C134	CAPACITOR, TRIMMER: 6.5-35 uuf	3115-2	1.25
C135	Same as C106		
C136	CAPACITOR, MICA: 27 uuf, 10%, 500 Volts	3095-45	.25
C137	CAPACITOR, PLASTIC COATED: .005 uf, 400 Volts	3105-220	.20
C138	CAPACITOR, OIL FILLED: .5 uf, 2000 Volts	3105-185	4.25
C139	Same as C138		
C140	Same as C101		
C141	CAPACITOR, PLASTIC: .05 uf, 600 Volts	3105-211	.20
C142	Same as C101		
C143	Same as C101		
C144	Same as C101		
C145	CAPACITOR, CERAMIC: 100 uuf, 10%	3110-21	.30
C146	Same as C145		
C147	CAPACITOR, PLASTIC COATED: .025 uf, 1600 Volts	3105-201	.35
C148	Same as C126		
C149	Same as C126		
C150	CAPACITOR, PLASTIC COATED: .01 uf, 400 Volts	3105-177	.20
C151	Same as C105		
C152	CAPACITOR, TRIMMER: 3-12 uuf	3115-1	.80
C153	Not used		
C154	CAPACITOR, ELECTROLYTIC: 20-20-20-20 uf, 450 volts	3085-38	2.80
C155	CAPACITOR, TRIMMER: 5-25 uuf, NPO	3115-13	1.00
C156	Not used		
C157	CAPACITOR, PLASTIC COATED: .025 uf, 600 volts	3105-169	.20
C158	CAPACITOR, METALLIZED: 1 uf, 200 volts	3105-144	1.85
C159	Same as C106		
CR101	CRYSTAL: 1N82A	3870-54	1.25

Ref. Desig.	Name and Description	Hickok Part No.	Price Each
5	TUBE: regulator, 6143	20875-133	10.75
6	TUBE: 1X2B	20875-122	3.05
7	TUBE: 6X4	20875-68	1.65
	ATTENUATOR ASSY	1920-18	29.95
	CABLE ASSEMBLY	3030-41	6.00
	MODULATION UNIT	3110-52	4.10
	MANUAL, INSTRUCTION:	2490-508	1.50

Ref. Desig.	Name and Description	Hickok Part No.	Price Each
R145	RESISTOR, FIXED, COMPOSITION: 180 ohms, 5%, 1/2 watt	18411-181	.25
R146	RESISTOR, FIXED, COMPOSITION: 47 ohms, 5%, 1/2 watt	18410-471	.25
R147	Same as R146		
R148	Same as R146		
R149	Same as R137		
R150	Not used		
R151	Same as R118		
R152	Same as R118		
R153	POTENTIOMETER: 1 megohm, with switch	16925-65	2.00
R154	RESISTOR, FIXED, COMPOSITION: 33 ohms, 5%, 1/2 watt	18410-331	.25
R155	RESISTOR, FIXED, COMPOSITION: 5.6 ohms, 5%, 1/2 watt	18450-39	.50
R156	Same as R155		
R157	Same as R155		
R158	Same as R138		
R159	RESISTOR, FIXED, COMPOSITION: 470K ohms, 10%, 1/2 watt	18414-472	.15
R160	RESISTOR, FIXED, COMPOSITION: 3.3 megohms, 10%, 1 watt	18425-332	.20
R161	RESISTOR, FIXED, COMPOSITION: 3.9 megohms, 10%, 1 watt	18425-392	.20
S101	SWITCH, WAFER: sweep frequency	19912-309	3.25
S102	SWITCH, ROTARY: 4 position, 3 pole	19912-267	4.15
S103	SWITCH, TOGGLE: SPST	19911-9	.50
S104	Same as S103		
S105	SWITCH, WAFER: sweep width	19912-310	2.95
S106	Same as S103		
S107	SWITCH, ROTARY: 1 section, single pole, double throw	19912-313	2.15
S108	Part of R153		
S109	SWITCH, ROTARY: 1 section, 5 position	19912-106	2.25
T1	TRANSFORMER: power	20800-315	16.95
T2	TRANSFORMER: modulation	20800-171	3.00
V1	TUBE: 6J6	20875-71	2.80
V2	Same as V1		
V3	TUBE: 12AT7	20875-77	3.05
V4	TUBE: 12AU7	20875-69	2.45

Ref. Desig.	Name and Description	Hickok Part No.	Price Each
R112	RESISTOR, FIXED, COMPOSITION: 15 ohms, 10%, 1/2 watt	18410-152	.15
R113	Same as R111		
R114	RESISTOR, FIXED, COMPOSITION: 6800 ohms, 10%, 1/2 watt	18412-682	.15
R115	RESISTOR, FIXED, COMPOSITION: 47 ohms, 10%, 1/2 watt	18410-472	.15
R116	RESISTOR, FIXED, COMPOSITION: 1000 ohms, 10%, 1/2 watt	18412-102	.15
R117	RESISTOR, FIXED, COMPOSITION: 560 ohms, 10%, 1/2 watt	18411-562	.15
R118	RESISTOR, FIXED, COMPOSITION: 4700 ohms, 10%, 1/2 watt	18412-472	.15
R119	Same as R118		
R120	Same as R116		
R121	Same as R116		
R122	RESISTOR, FIXED, COMPOSITION: 27,000 ohms, 10%, 1/2 watt	18413-272	.15
R123	RESISTOR, FIXED, COMPOSITION: 15,000 ohms, 10%, 1/2 watt	18413-152	.15
R124	RESISTOR, FIXED, COMPOSITION: 560K ohms, 10%, 1/2 watt	18414-562	.15
R125	RESISTOR, FIXED, COMPOSITION: 330K ohms, 10%, 1/2 watt	18414-332	.15
R126	RESISTOR, FIXED, COMPOSITION: 820K ohms, 10%, 1/2 watt	18414-822	.15
R127	RESISTOR, FIXED, COMPOSITION: 1200 ohms, 10%, 1/2 watt	18412-122	.15
R128	Same as R106		
R129	RESISTOR, FIXED, COMPOSITION: 10,000 ohms, 10%, 1/2 watt	18413-102	.15
R130	RESISTOR, FIXED, COMPOSITION: 10 megohms, 10%, 1/2 watt	18416-102	.15
R131	RESISTOR, FIXED, COMPOSITION: 180K ohms, 10%, 1/2 watt	18414-182	.15
R132	RESISTOR, FIXED, COMPOSITION: 1800 ohms, 10%, 1/2 watt	18412-182	.15
R133	Same as R116		
R134	Same as R122		
R135	POTENTIOMETER: 200 ohms, 2 watt	16925-100	2.95
R136	RESISTOR, FIXED, COMPOSITION: 100 ohms, 5%, 1/2 watt	18411-101	.25
R137	RESISTOR, FIXED, COMPOSITION: 470 ohms, 10%, 1/2 watt	18411-472	.15
R138	RESISTOR, FIXED, COMPOSITION: 220 ohms, 10%, 1/2 watt	18411-222	.15
R139	Not used		
R140, R141	POTENTIOMETER: dual, 400 ohms	16925-262	2.55
R142	RESISTOR, FIXED, COMPOSITION: 270 ohms, 10%, 1/2 watt	18411-272	.15
R143	RESISTOR, FIXED, COMPOSITION: 10,000 ohms, 10%, 2 watt	18433-102	.25
R144	Same as R143		

Ref. Desig.	Name and Description	Hickok Part No.	Price Each
CR102	Same as CR101		
CR103	CRYSTAL: 4.5 mc, accuracy .05%	3870-23	7.95
CR104	Same as CR101		
CR105	CRYSTAL: 1N-34A	3870-2	.50
F101	FUSE: 1/2 Amp, SLO-BLO	6900-15	.30
F102	FUSE: 1/16 Amp, SLO-BLO	6900-16	.30
L101	COIL ASSY: FM Sweep Osc.	3320-105	5.00
L102	COIL ASSY	3320-106	6.95
L103	Same as L102		
L104	COIL ASSY: 2.5-5.5 mc.	3320-101	2.00
L105	COIL ASSY: 19 to 50 mc	3320-78	5.25
L106	COIL ASSY: 54-108 mc	3320-100	1.95
L107	CHOKE ASSY: 30 turns	3250-50	1.25
L108	Same as L107		
L109	Same as L107		
L110	Same as L107		
L111	CHOKE: current 50 ma, 600 ohms	3250-19	3.50
L112	Not used		
L113	COIL ASSY: 4 turns	3320-102	1.95
L114	Not used		
L115	CHOKE ASSEMBLY: 50 turns	3250-17	1.65
R101	RESISTOR, FIXED, COMPOSITION: 3300 ohms, 10%, 2 watt	18432-332	.25
R102	RESISTOR, FIXED, COMPOSITION: 3000 ohms, 5%, 1 watt	18422-301	.35
R103	Same as R102		
R104	RESISTOR, FIXED, COMPOSITION: 47,000 ohms, 10%, 2 watt	18433-472	.25
R105	RESISTOR, FIXED, COMPOSITION: 27,000 ohms, 10%, 2 watt	18433-272	.25
R106	RESISTOR, FIXED, COMPOSITION: 3300 ohms, 10%, 1/2 watt	18412-332	.15
R107	Same as R105		
R108	RESISTOR, FIXED, COMPOSITION: 82,000 ohms, 10%, 1/2 watt	18413-822	.15
R109	RESISTOR, FIXED, COMPOSITION: 100K ohms, 10%, 1/2 watt	18414-102	.15
R110	RESISTOR, FIXED, COMPOSITION: 100 ohms, 10%, 1/2 watt	18411-102	.15
R111	RESISTOR, FIXED, COMPOSITION: 47,000 ohms, 5%, 1/2 watt	18413-471	.15



NOTE
ALL CAPA
ARE IN MIC
ARE IN MIC
ALL RESIS
UNLESS OT
K= 1,000 O
M= 1,000,0
*= GROUNE
ALL SWITC
POSITION A
**RX= CAL
R13

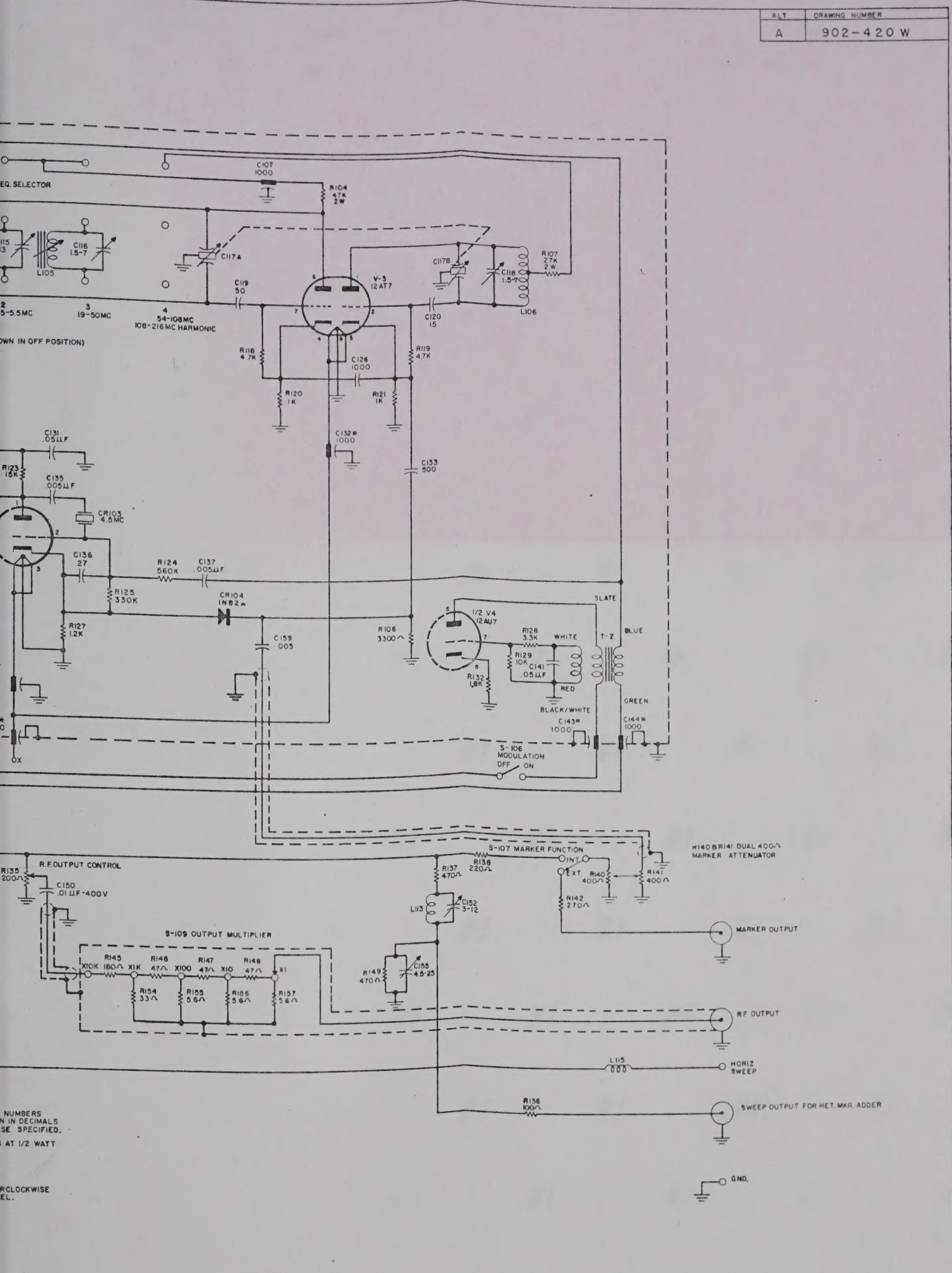


Figure 4-2. Schematic Wiring Diagram